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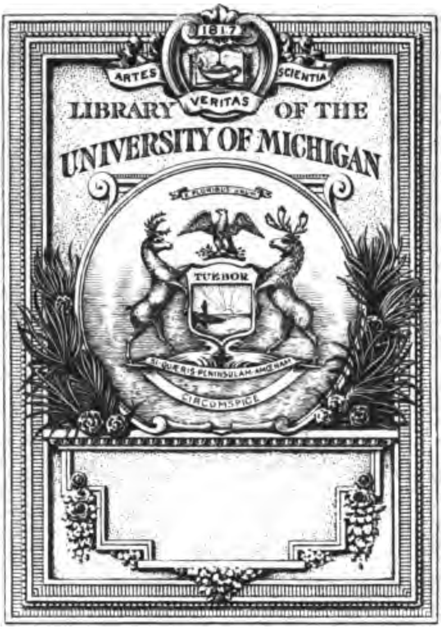

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FIRST REPORT

OF

THE SECRETARY OF THE SMITHSONIAN INSTITUTION

TO THE

BOARD OF REGENTS;

GIVING

A PROGRAMME OF ORGANIZATION, AND AN ACCOUNT OF THE OPERATIONS DURING THE YEAR.

PRESENTED DECEMBER 8, 1847.

SMITHSONIAN INSTITUTION.
ORGANIZED A.D. 1846.

WASHINGTON:
RITCHIE & HEISS, PRINTERS.
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REPORT.

GENTLEMEN: A statement of the financial condition of the Smithsonian Institution, and of the progress made in the erection of the building, having been presented to your board by the committees charged with the care of these objects, it becomes my duty, as Secretary of the institution, to give an account of what has been done relative to the development of the plan of organization, and of the steps which have been taken in the way of carrying it into operation.

In accordance with my instructions, I consulted with men of eminence, in the different branches of literature and science, relative to the details of the plan of organization, and arranged the various suggestions offered, in the form of the accompanying programme. This, after having been submitted to a number of persons in whose knowledge and judgment I have confidence, is now presented to the board, with the concurrence of the Committee on Organization, for consideration and provisional adoption. I regret that my engagements have been such as to render it impossible for me to call upon many persons whose counsel would have been valuable, but I hope hereafter to avail myself of their advice in behalf of the institution. I also regret that I could not give the names of those whose suggestions have been adopted in the programme; the impossibility of rendering justice to all, has prevented my attempting this. Many of the suggestions have been offered by different persons, independently of each other; and, indeed, the general plan of the increase and diffusion of knowledge as adopted by the board, is such as would naturally arise in the mind of any person conversant with the history of physical science, and with the means usually employed for its extension and diffusion.

The introduction to the programme contains a series of propositions, suggested by a critical examination of the will of Smithson, to serve as a guide in judging of the fitness of any proposed plan for carrying out the design of the testator. The first section of the programme gives the details of the plan proposed for the increase and diffusion of knowledge by means of publication and original researches. The second section furnishes the details, so far as they can be made out at the present time, of the formation of a library, and a collection of objects of nature and art. These two plans combined, embrace the general propositions adopted by the Board of Regents at their last meeting, as the basis of future operations. It is intended in the proposed plan to harmonize the two modes of increasing and diffusing knowledge, and to give to the institution the widest influence compatible with its limited income. That all the propositions will meet with general approval cannot be expected; and that this organization is the best that could be devised is neither asserted nor believed. To produce *a priori* a plan of organization which shall be found to succeed perfectly in practice, and require no amendment, would be difficult under the most favorable circumstances, and becomes almost impossible where conflicting opinions are to be harmonized, and the definite requirements of the act establishing the institution are to be observed. It is not intended that the details of the organization, as given in the programme, should be permanently adopted without careful trial; they are rather presented as suggestions to be adopted provisionally, and to be carried into operation gradually and cautiously, with such changes, from time to time, as experience may dictate.

PROGRAMME OF ORGANIZATION OF THE SMITHSONIAN INSTITUTION.

[Presented to the Board of Regents December 8, 1847.]

INTRODUCTION.

General considerations which should serve as a guide in adopting a plan of organization.

1. Will of Smithson. The property is bequeathed to the United States of America, "to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men."

2. The bequest is for the benefit of mankind. The government of the United States is merely a trustee to carry out the design of the testator.

3. The institution is not a national establishment, as is frequently supposed, but the establishment of an individual, and is to bear and perpetuate his name.

4. The objects of the institution are—1st, to increase, and 2d, to diffuse knowledge among men.

5. These two objects should not be confounded with one another. The first is to increase the existing stock of knowledge by the addition of new truths; and the second to disseminate knowledge, thus increased, among men.

6. The will makes no restriction in favor of any particular kind of knowledge; hence all branches are entitled to a share of attention.

7. Knowledge can be increased by different methods of facilitating and promoting the discovery of new truths, and can be most efficiently diffused among men by means of the press.

8. To effect the greatest amount of good, the organization should be such as to enable the institution to produce results in the way of increasing and diffusing knowledge, which cannot be produced by the existing institutions in our country.

9. The organization should also be such as can be adopted provisionally, can be easily reduced to practice, receive modifications, or be abandoned, in whole or in part, without a sacrifice of the funds.

10. In order to make up for the loss of time occasioned by the delay of eight years in establishing the institution, a considerable portion of the interest which has accrued should be added to the principal.

11. In proportion to the wide field of knowledge to be cultivated, the funds are small. Economy should therefore be consulted in the construction of the building; and not only should the first cost of the edifice be considered, but also the continual expense of keeping it in repair, and of the support of the establishment necessarily connected with it. There should also be but few individuals permanently supported by the institution.

12. The plan and dimensions of the building should be determined by the plan of the organization, and not the converse.

13. It should be recollected that mankind in general are to be benefited by the bequest, and that, therefore, all unnecessary expenditure on local objects would be a perversion of the trust.

14. Besides the foregoing considerations, deduced immediately from the will of Smithson, regard must be had to certain requirements of the act of Congress establishing the institution. These are a library, a museum, and a gallery of art, with a building on a liberal scale to contain them.

SECTION I.

Plan of organization of the institution, in accordance with the foregoing deductions from the will of Smithson.

To INCREASE KNOWLEDGE. It is proposed—

1. To stimulate men of talent to make original researches, by offering suitable rewards for memoirs containing new truths; and,

2. To appropriate annually a portion of the income for particular researches, under the direction of suitable persons.

To DIFFUSE KNOWLEDGE. It is proposed—

1. To publish a series of periodical reports on the progress of the different branches of knowledge; and,

2. To publish occasionally separate treatises on subjects of general interest.

DETAILS OF THE PLAN TO INCREASE KNOWLEDGE.

I. *By stimulating researches.*

1. Rewards, consisting of money, medals, &c., offered for original memoirs on all branches of knowledge.

2. The memoirs thus obtained to be published in a series of volumes, in a quarto form, and entitled "Smithsonian Contributions to Knowledge."

3. No memoir, on subjects of physical science, to be acccepted for publication, which does not furnish a positive addition to human knowledge resting on original research; and all unverified speculations to be rejected.

4. Each memoir presented to the institution to be submitted for examination to a commission of persons of reputation for learning in the branch to which the memoir pertains, and to be accepted for publication only in case the report of this commission is favorable.

5. The commission to be chosen by the officers of the institution, and the name of the author, as far as practicable, concealed, unless a favorable decision be made.

6. The volumes of the memoirs to be exchanged for the Transactions of literary and scientific societies, and copies to be given to all the colleges and principal libraries in this country. One part of the remaining copies may be offered for sale; and the other carefully preserved, to form complete sets of the volumes, to supply the demand from new institutions.

7. An abstract, or popular account, of the contents of these memoirs to be given to the public through the annual report of the Regents to Congress.

II. *By appropriating a portion of the income, annually, to special objects of research, under the direction of suitable persons.*

1. The objects, and the amount appropriated, to be recommended by counsellors of the institution.

2. Appropriations in different years to different objects; so that in course of time, each branch of knowledge may receive a share.

3. The results obtained from these appropriations to be published, with the memoirs before mentioned, in the volumes of the Smithsonian Contributions to Knowledge.

4. Examples of objects for which appropriations may be made.

(1.) System of extended meteorological observations, for solving the problem of American storms.

(2.) Explorations in descriptive natural history, and geological, magnetical, and topographical surveys, to collect materials for the formation of a Physical Atlas of the United States.

(3.) Solution of experimental problems, such as a new determination of the weight of the earth, of the velocity of electricity, and of light; chemical analyses of soils and plants; collection and publication of articles of science, accumulated in the offices of government.

(4.) Institution of statistical inquiries with reference to physical, moral, and political subjects.

(5.) Historical researches, and accurate surveys of places celebrated in American history.

(6.) Ethnological researches, particularly with reference to the different races of men in North America; also explorations and accurate surveys of the mounds and other remains of the ancient people of our country.

DETAILS OF THE PLAN FOR DIFFUSING KNOWLEDGE.

I. *By the publication of a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge not strictly professional.*

1. These reports will diffuse a kind of knowledge generally interesting, but which, at present, is inaccessible to the public. Some of the reports may be published annually, others at longer intervals, as the income of the institution, or the changes in the branches of knowledge, may indicate.
2. The reports are to be prepared by collaborators, eminent in the different branches of knowledge.
3. Each collaborator to be furnished with the journals and publications, domestic and foreign, necessary to the compilation of his report; to be paid a certain sum for his labors, and to be named on the title-page of the report.
4. The reports to be published in separate parts, so that persons interested in a particular branch can procure the parts relating to it, without purchasing the whole.
5. These reports may be presented to Congress, for partial distribution; the remaining copies to be given to literary and scientific institutions, and sold to individuals for a moderate price.

The following are some of the subjects which may be embraced in the reports.

I. PHYSICAL CLASS.

1. Physics, including astronomy, natural philosophy, chemistry, and meteorology.
2. Natural history, including botany, zoology, geology, &c.
3. Agriculture.
4. Application of science to arts.

II. MORAL AND POLITICAL CLASS.

5. Ethnology, including particular history, comparative philology, antiquities, &c.
6. Statistics and political economy.
7. Mental and moral philosophy.
8. A survey of the political events of the world; penal reform, &c.

III. LITERATURE AND THE FINE ARTS.

9. Modern literature.
10. The fine arts, and their application to the useful arts.
11. Bibliography.
12. Obituary notices of distinguished individuals.

II. *By the publication of separate treatises on subjects of general interest.*

1. These treatises may occasionally consist of valuable memoirs, translated from foreign languages, or of articles prepared under the direction of the institution, or procured by offering premiums for the best exposition of a given subject.

2. The treatises should in all cases be submitted to a commission of competent judges previous to their publication.

3. As examples of these treatises, expositions may be obtained of the present state of the several branches of knowledge mentioned in the table of reports. Also of the following subjects, suggested by the Committee on Organization, viz: the statistics of labor, the productive arts of life, public instruction, &c.

SECTION II.

Plan of organization, in accordance with the terms of the resolutions of the Board of Regents, providing for the two modes of increasing and diffusing knowledge.

1. The act of Congress establishing the institution contemplated the formation of a library and a museum; and the Board of Regents, including these objects in the plan of organization, resolved to divide the income into two equal parts.

2. One part to be appropriated to increase and diffuse knowledge by means of publications and researches, agreeably to the scheme before given. The other part to be appropriated to the formation of a library and a collection of objects of nature and of art.

3. These two plans are not incompatible with one another.

4. To carry out the plan before described, a library will be required, consisting, 1st, of a complete collection of the transactions and proceedings of all the learned societies in the world; 2d, of the more important current periodical publications, and other works necessary in preparing the periodical reports.

5. The institution should make special collections, particularly of objects to verify its own publications.

6. Also a collection of instruments of research in all branches of experimental science.

7. With reference to the collection of books, other than those mentioned above, catalogues of all the different libraries in the United States should be procured, in order that the valuable books first purchased may be such as are not to be found in the United States.

8. Also catalogues of memoirs, and of books in foreign libraries, and other materials, should be collected for rendering the institution a centre of bibliographical knowledge, whence the student may be directed to any work which he may require.

9. It is believed that the collections in natural history will increase by donation, as rapidly as the income of the institution can make provision for their reception, and therefore it will seldom be necessary to purchase any articles of this kind.

10. Attempts should be made to procure for the gallery of arts casts of the most celebrated articles of ancient and modern sculpture.

11. The arts may be encouraged by providing a room, free of expense, for the exhibition of the objects of the Art-Union and other similar societies.

12. A small appropriation should annually be made for models of antiquities, such as those of the remains of ancient temples, &c.

13. For the present, or until the building is fully completed, besides the Secretary, no permanent assistant will be required, except one, to act as librarian.

14. The duty of the Secretary will be the general superintendence, with the advice of the Chancellor and other members of the establishment, of the literary and scientific operations of the institution; to give to the Regents annually an account of all the transactions; of the memoirs which have been received for publication; of the researches which have been made; and to edit, with the assistance of the librarian, the publications of the institution.

15. The duty of the Assistant Secretary, acting as librarian, will be, for the present, to assist in taking charge of the collections, to select and purchase, under the direction of the Secretary and a committee of the board, books and catalogues, and to procure the information before mentioned; to

give information on plans of libraries, and to assist the Secretary in editing the publications of the institution and in the other duties of his office.

16. The Secretary and his assistants, during the session of Congress, will be required to illustrate new discoveries in science, and to exhibit new objects of art; also distinguished individuals should be invited to give lectures on subjects of general interest.

17. When the building is completed, and when, in accordance with the act of Congress, the charge of the National Museum is given to the Smithsonian Institution, other assistants will be required.

Explanations and illustrations of the programme.

Though the leading propositions of the programme have been fully discussed by the board, yet it will be important to offer some remarks in explanation and illustration of them in their present connexion.

That the institution is not a national establishment, in the sense in which institutions dependent on the government for support are so, must be evident when it is recollected that the money was not absolutely given to the United States, but intrusted to it for a special object, namely: the establishment of an institution for the benefit of men, to bear the name of the donor, and, consequently, to reflect upon his memory the honor of all the good which may be accomplished by means of the bequest. The operations of the Smithsonian Institution ought, therefore, to be mingled as little as possible with those of the government, and its funds should be applied exclusively and faithfully to the increase and diffusion of knowledge among men.

That the bequest is intended for the benefit of men in general, and that its influence ought not to be restricted to a single district, or even nation, may be inferred not only from the words of the will, but also from the character of Smithson himself; and I beg leave to quote, from a scrap of paper in his own hand, the following sentiment bearing on this point: "The man of science has no country; the world is his country—all men, his countrymen." The origin of the funds, the bequest of a foreigner, should also preclude the adoption of a plan which does not, in the words of Mr. Adams, "spread the benefits to be derived from the institution not only over the whole surface of this Union, but throughout the civilized world." "Mr. Smithson's reason for fixing the seat of his institution at Washington, obviously was, that *there* is the seat of government of the United States, and *there* the Congress by whose legislation, and the Executive through whose agency, the trust committed to the honor, intelligence, and good faith of the nation, is to be fulfilled." The centre of operations being permanently fixed at Washington, the character of this city for literature and science will be the more highly exalted in proportion as the influence of the institution is more widely diffused.

That the terms *increase* and *diffusion* of knowledge are logically distinct, and should be literally interpreted with reference to the will, must be evident when we reflect that they are used in a definite sense, and not as mere synonymes, by all who are engaged in the pursuits to which Smithson devoted his life. In England there are two classes of institutions, founded on the two ideas conveyed by these terms. The Royal Society, the Astronomical, the Geological, the Statistical, the Antiquarian Societies, all have for their object the increase of knowledge; while the London Institution, the Mechanics' Institution, the Surry Institution, the Society for the Diffusion of Religious Knowledge, the Society for the Diffusion of Useful Knowledge, are all intended to diffuse or disseminate knowledge among men. In our own country, also, the same distinction is observed in the use of the terms by men of science. Our colleges, academies, and common schools, are recognised as institutions partially intended for the diffusion of knowledge, while the express object of some of our scientific societies is the promotion of the discovery of new truths.

The will makes no restriction in favor of any particular kind of knowledge; though propositions have been frequently made for devoting the funds exclusively to the promotion of certain branches of science having more immediate application to the practical arts of life, and the adoption of these propositions has been urged on the ground of the conformity of such objects to the pursuits of Smithson; but an examination of his writings will show that he excluded from his own studies no branch of general knowledge, and that he was fully impressed with the important philosophical fact, that all subjects of human thought relate to one great system of truth. To restrict, therefore, the operations of the institution to a single science or art, would do injustice to the character of the donor, as well as to the cause of general knowledge. If preference is to be given to any branches of research, it should be to the higher, and apparently more abstract; to the discovery of new principles, rather than of isolated facts. And this is true even in a practical point of view. Agriculture would have forever remained an empirical art, had it not been for the light shed upon it by the atomic theory of chemistry; and incomparably more is to be expected as to its future advancement from the perfection of the microscope, than from improvements in the ordinary instruments of husbandry.

The plan of increasing and diffusing knowledge, presented in the first section of the programme, will be found in strict accordance with the several propositions deduced from the will of Smithson, and given in the introduction. It embraces, as a leading feature, the design of interesting the greatest number of individuals in the operations of the institution, and of spreading its influence as widely as possible. It forms an active organization, exciting all to make original researches who are gifted with the necessary power, and diffusing a kind of knowledge, now only accessible to the few, among all those who are willing to receive it. In this country, though many excel in the application of science to the practical arts of life, few devote themselves to the continued labor and patient thought necessary to the discovery and development of new truths. The principal cause of this want of attention to original research, is the want, not of proper means, but of proper encouragement. The publication of original memoirs and periodical reports, as contemplated by the programme, will act as a powerful stimulus on the latent talent of our country, by placing in bold relief the real laborers in the field of original research, while it will afford the best materials for the use of those engaged in the diffusion of knowledge.

The advantages which will accrue from the plan of publishing the volumes of the Smithsonian Contributions to Knowledge, are various. In the first place, it will serve to render the name of the founder favorably known wherever literature and science are cultivated, and to keep it in continual remembrance with each succeeding volume, as long as knowledge is valued. A single new truth, first given to the world through these volumes, will forever stamp their character as a work of reference. The contributions will thus form the most befitting monument to perpetuate the name of one whose life was devoted to the increase of knowledge, and whose ruling passion, strong in death, prompted the noble bequest intended to facilitate the labors of others in the same pursuit.

Again, the publication of a series of volumes of original memoirs will afford to the institution the most ready means of entering into friendly relations and correspondence with all the learned societies in the world, and of enriching its library with their current transactions and proceedings. But perhaps the most important effect of the plan will be that of giving to the world many valuable memoirs, which, on account of the expense of the illustrations, could not be otherwise published. Every one who adds new and important truths to the existing stock of knowledge, must be of necessity, to a certain degree, in advance of his age. Hence the number of readers and purchasers of a work is generally in the inverse ratio of its intrinsic value; and consequently, authors of the highest rank of merit are frequently deterred from giving their productions to the world on account of the pecuniary loss to which the publication would subject them. When our lamented countryman, Bowditch, contemplated publishing his commentary on La Place, he assembled his family and informed them that the execution of this design would sacrifice one-third of his fortune, and that it was proper his heirs should be consulted on a subject which so nearly concerned them. The answer was worthy of the children of such a father: "We value," said they, "your reputation more than your money." Fortunately, in this instance, the means of making such a sacrifice existed; otherwise one of the proudest monuments of American science could not have been given to the world. In the majority of cases, however, those who are most capable of extending human knowledge are least able to incur the expense of the publication. Wilson, the American Ornithologist, states, in a letter to Michaux, that he has sacrificed everything to publish his work: "I have issued," he says, "six volumes, and am engaged on the seventh, but as yet I have not received a single cent of the proceeds." In an address on the subject of natural history, by one of our most active cultivators of this branch of knowledge, we find the following remarks, which are directly in point: "Few are acquainted with the fact that from the small number of scientific works sold, and the great expense of plates, our naturalists not only are not paid for their labors, but suffer pecuniary loss from their publications. Several works on different branches of zoology, now in the course of publication, will leave their authors losers by an aggregate of $15,000. I do not include in this estimate works already finished—one, for instance, the best contribution to the natural history of man extant, the publication of which will occasion its accomplished author a loss of several thousand dollars. A naturalist is extremely fortunate if he can dispose of 200 copies of an illustrated work, and the number of copies printed rarely exceeds 250." It may be said that these authors have their reward in the reputation which they thus purchase; but reputation should be the result of the talents and labor expended in the production of a work, and should not in the least depend upon the fact that the author is able to make a pecuniary sacrifice in giving the account of his discoveries to the public.

Besides the advantage to the author of having his memoir published in the Smithsonian Contributions free of expense, his labors will be given to the world with the stamp of approval of a commission of learned men; and his merits will be generally made known through the reports of the institution. Though the premiums offered may be small, yet they will have considerable effect in producing original articles. Fifty or a hundred dollars awarded to the author of an original paper, will, in many instances, suffice to supply the books, or to pay for the materials, or the manual labor required, in prosecuting the research.

There is one proposition of the programme which has given rise to much discussion, and which, therefore, requires particular explanation; I allude to that which excludes from the contributions all papers consisting merely of unverified speculations on subjects of physical science. The object of this proposition is to obviate the endless difficulties which would occur in rejecting papers of an unphilosophical character; and though it may in some cases exclude an interesting communication, yet the strict observance of it will be found of so much practical importance that it cannot be dispensed with. It has been supposed, from the adoption of this proposition, that we are disposed to undervalue abstract speculations: on the contrary, we know that all the advances in true science—namely, a knowledge of the laws of phenomena—are made by provisionally adopting well-conditioned hypotheses, the product of the imagination, and subsequently verifying them by an appeal to experiment and observation. Every new hypothesis of scientific value must not only furnish an exact explanation of known facts, but must also enable us to predict, in kind and quantity, the phenomena which will be exhibited under any given combination of circumstances. Thus, in the case of the undulatory hypothesis of light, it was inferred, as a logical consequence, that if the supposition were true that light consisted of waves of an ethereal medium, then two rays of light, like two waves of water under certain conditions, should annihilate each other, and darkness be produced. The experiment was tried, and the anticipated result was obtained. It is this exact agreement of the deduction with the actual result of experience that constitutes the verification of an hypothesis, and which alone entitles it to the name of a theory, and to a place in the Transactions of a scientific institution. It must be recollected that it is much easier to speculate than to investigate, and that very few of all the hypotheses imagined are capable of standing the test of scientific verification.

For the practical working of the plan for obtaining the character of a memoir, and the precaution taken before it is accepted for publication, I would refer to the correspondence, given in a subsequent part of this report, relative to the memoir now in process of publication by the institution. As it is not our intention to interfere with the proceedings of other institutions, but to co-operate with them, so far as our respective operations are compatible, communications may be referred to learned societies for inspection, as in the case of the above mentioned memoir, and abstracts of them given to the world through the bulletins of these societies, while the details of the memoirs and their expensive illustrations are published in the volumes of the Smithsonian Contributions. The officers of several learned societies in this country have expressed a willingness to co-operate in this way.

Since original research is the most direct way of increasing knowledge, it can scarcely be doubted that a part of the income of the bequest should be appropriated to this purpose, provided suitable persons can be found, and their labors be directed to proper objects. The number, however, of those who are capable of discovering scientific principles is comparatively small; like the poet, they are "born, not made," and, like him, must be left to choose their own subject, and wait the fitting time of inspiration. In case a person of this class has fallen on a vein of discovery, and is pursuing it with success, the better plan will be to grant him a small sum of money to carry on his investigations, provided they are considered worthy of assistance by competent judges. This will have the double effect of encouraging him in the pursuit, and of facilitating his progress. The institution, however, need not depend upon cases of this kind, even if they were more numerous than they are, for the application of its funds in the line of original research. There are large fields of observation and experiment, the cultivation of which, though it may afford no prospect of the discovery of a principle, can hardly fail to produce results of importance both in a practical and a theoretic point of view. As an illustration of this remark, I may mention the case of the investigations made a few years ago by committees of the Franklin Institute, of Philadelphia. The Secretary of the Treasury of the United States placed at the disposal of this society a sum of money, for the purpose of making experiments with reference to the cause of the explosion of steam-boilers. A committee of the society was chosen for this purpose, which adopted the ingenious plan of writing to all persons in the United States engaged in the application of steam, and particularly to those who had observed the explosion of a steam-boiler. In this way opinions and suggestions in great variety, as to the cause of explosions, were obtained. The most plausible of these were submitted to the test of experiment: the results obtained were highly important, and are to be found favorably mentioned in every systematic work on the subject of steam which has appeared, in any language, within the last few years. New and important facts were established; and, what was almost of as much consequence, errors which had usurped the place of truth were dethroned.

In the programme, examples are given of a few subjects of original research to which the attention of the institution may be turned. I will mention one in this place, which, in connexion with the contents of our first memoir, may deserve immediate attention. I allude to a small appropriation made annually for researches with reference to the remains of the ancient inhabitants of our country. This is a highly interesting field, and what is done in regard to it should be done quickly. Every year the progress of civilization is obliterating the ancient mounds, cities and villages are rising on the spots they have so long occupied undisturbed, and the distinctive marks of these remains are every year becoming less and less legible.

In carrying out the spirit of the plan adopted, namely, that of affecting men in general by the operations of the institution, it is evident that the principal means of diffusing knowledge must be the *press*. Though lectures should be given in the city in which Smithson has seen fit to direct the establishment of his institution, yet, as a plan of general diffusion of knowledge, the system of lectures would be entirely inadequate; every village in our extended country would have a right to demand a share of the benefit, and the income of the institution would be insufficient to supply a thousandth part of the demand. It is also evident that the knowledge diffused should, if possible, not only embrace all branches of general interest, so that each reader might find a subject suited to his taste, but also that it should differ in kind and quality from that which can be readily obtained through the cheap publications of the day. These requisites will be fully complied with in the publications of the series of reports proposed in the programme. A series of periodicals of this kind, posting up all the discoveries in science from time to time, and giving a well digested account of all the important changes in the different branches of knowledge, is a desideratum in the English language. The idea is borrowed from a partial plan of this kind in operation in Sweden and Germany; and for an example of what the work should be, I would refer to the annual report to the Swedish Academy of its perpetual Secretary, Berzelius, on physical science. The reports can be so prepared as to be highly interesting to the general reader, and at the same time of great importance to the exclusive cultivator of a particular branch of knowledge. Full references should be given, in foot-notes, to the page, number, or volume of the work from which the information was obtained, and where a more detailed account can be found. It is scarcely necessary to remark, that the preparation of these reports should be intrusted only to persons profoundly acquainted with the subjects to which they relate—namely, to those who are devoted to particular branches, while they possess a knowledge of general principles. Sufficient explanations should be introduced to render the report intelligible to the general reader, without destroying its scientific character. Occasionally reports may be obtained from abroad—as, for example, accounts of the progress of certain branches of knowledge in foreign countries—and these may be translated, if necessary, and incorporated into other reports, by some competent person in this country.

Besides the reports on the progress of knowledge, the programme proposes to publish occasionally brief treatises on particular subjects. There are always subjects of general interest, of which brief expositions would be of much value. The preparation of these, however, should be intrusted to none but persons of character and reputation, and should be subjected to a revision by competent and responsible judges before they are given to the public. They may be presented in the form of reports on the existing state of knowledge relative to a given subject, and may sometimes consist of memoirs and expositions of particular branches of literature and science, translated from foreign languages. The reports and treatises of the institution, sold at a price barely sufficient to pay the expense of printing, will find their way into every school in our country, and will be used not as first lessons for the pupil, but as sources of reliable information for the teacher.

The second section of the programme gives, so far as they have been made out, the details of the part of the plan of organization directed by the act of Congress establishing the institution. The two plans, namely, that of publication and original research, and that of collections of objects of nature and art, are not incompatible, and may be carried on harmoniously with each other. The only effect which they will have on one another is that of limiting the operation of each, on account of the funds given to the other. Still, with a judicious application, and an economical expenditure of the income, and particularly by rigidly observing the plan of finance, suggested by Dr. Bache, in the construction of the building, much good may be effected in each of the two branches of the institution. To carry on the operations of the first, a working library will be required, consisting of the past volumes of the transactions and proceedings of all the learned societies in every language. These are the original sources from which the most important principles of the positive knowledge of our day have been drawn. We shall also require a collection of the most important current literature and science for the use of the collaborators of the reports; most of these, however, will be procured in exchange for the publications of the institution, and therefore will draw but little from the library fund. For other suggestions relative to the details of the library, I would refer you to the annexed communication from Professor Jewett, Assistant Secretary, acting as librarian. (See appendix No. 1.)

The collections of the institution, as far as possible, should consist of such articles as are not elsewhere to be found in this country, so that the visitors at Washington may see new objects, and the spirit of the plan be kept up, of interesting the greatest possible number of individuals. A perfect collection of all objects of nature and of art, if such could be obtained and deposited in one place, would form a museum of the highest interest; but the portion of the income of the bequest which can be devoted to the increase and maintenance of the museum, will be too small to warrant any attempt towards an indiscriminate collection. It is hoped that in due time other means may be found of establishing and supporting a general collection of objects of nature and art at the seat of the general government, with funds not derived from the Smithsonian bequest. For the present, it should be the object of the institution to confine the application of the funds, first, to such collections as will tend to facilitate the study of the memoirs which may be published in the Contributions, and to establish their correctness; secondly, to the purchase of such objects as are not generally known in this country, in the way of art, and the illustration of antiquities, such as models of buildings, &c.; and, thirdly, to the formation of a collection of instruments of physical research, which will be required both in the illustration of new physical truths, and in the scientific investigations undertaken by the institution.

Much popular interest may be awakened in favor of the institution at Washington, by throwing the rooms of the building open, on stated evenings during the session of Congress, for literary and scientific assemblies, after the manner of the weekly meetings of the Royal Institution in London. At these meetings, without the formality of a regular lecture, new truths in science may be illustrated, and new objects of art exhibited. Besides these, courses of lectures may be given on particular subjects by the officers of the institution, or by distinguished individuals invited for the purpose.

Commencement of the operations of the institution.

I was authorized, in connexion with the Committee on Organization, to commence the publication of the Smithsonian Contributions to Knowledge, and to receive any memoir which might be presented on any subject, provided it was found, on examination, to furnish an interesting addition to the sum of human knowledge, resting on original research. The first memoir presented, and found to be of the character prescribed by the resolution of the board, was one on the remains of the ancient inhabitants of the North American continent. It contains the result of several years' labor in the survey and exploration of the mounds and earthworks of the Mississippi valley, and will furnish a highly interesting addition to the antiquities of our country, which could not have been given to the world, but for the timely aid extended to it by this institution. The memoir was referred to the American Ethnological Society, with a request that a committee of its members might be appointed to examine and report on its character, as to fitness for publication in the Smithsonian Contributions to Knowledge. On the favorable report of this committee, and on the responsibility of the society, the memoir has been accepted for publication. The following correspondence will serve to give an account of the work, and to illustrate the manner in which it is proposed to submit the papers which may be presented for publication to a commission of competent judges.

CORRESPONDENCE RELATIVE TO THE ACCEPTANCE FOR PUBLICATION OF THE ETHNOLOGICAL MEMOIR OF MESSRS. SQUIER AND DAVIS.

From Messrs. Squier and Davis to the Secretary of the Smithsonian Institution.

CHILLICOTHE, O., *May* 15, 1847.

DEAR SIR: It is proposed in the recognised plan of organization of the Smithsonian Institution, of which you are the executive officer, to publish, under the title of "*Smithsonian Contributions to Knowledge,*" such original papers and memoirs "as shall constitute valuable additions to the sum of human knowledge." Under the belief that it falls legitimately within the scope of the above plan, the undersigned herewith submit for acceptance and publication, subject to the prescribed rules of the institution, a MS. memoir, entitled "ANCIENT MONUMENTS OF THE MISSISSIPPI VALLEY, *comprising the results of Extensive Original Surveys and Explorations:* by E. G. SQUIER and E. H. DAVIS." The extent of these investigations, and their general character, are sufficiently indicated in the prefatory remarks to the volume.

With high consideration, we are truly yours,

E. GEO. SQUIER.
E. H. DAVIS.

JOSEPH HENRY, Esq.,
Secretary Smithsonian Institution.

From the Secretary of the Smithsonian Institution to the President of the American Ethnological Society.

WASHINGTON, *June* 2, 1847.

DEAR SIR: I am authorized by the Regents of the Smithsonian Institution to publish, in the numbers of the "*Smithsonian Contributions to Knowledge,*" any memoir which may be presented for this purpose, provided that, on careful examination by a commission of competent judges, the memoir shall be found to furnish a new and interesting addition to knowledge, resting on original research. The accompanying memoir, entitled "*Ancient Monuments of the Mississippi Valley,*" *&c.*, having been presented for publication, I beg leave to refer the same, through you, to the American Ethnological Society, with the request that a committee of the members may be appointed to examine and report on its character, in reference to the particulars above mentioned. If the report of the committee be favorable, the memoir will be accepted for publication; full confidence being placed in the ability of the committee to judge of the character of the article, and in their caution in making up their opinion.

I have the honor to be, very respectfully, your obedient servant,

JOSEPH HENRY,
Secretary Smithsonian Institution.

Hon. ALBERT GALLATIN,
President American Ethnological Society.

Extract of a letter from the President of the American Ethnological Society to the Secretary of the Smithsonian Institution.

"NEW YORK, *June* 12, 1847.

"DEAR SIR: I have the honor to enclose a copy of the proceedings and resolutions of the New York Ethnological Society upon the MS. work on American Antiquities, by Messrs. E. G. Squier and E. H. Davis, submitted with your letter of the 2d inst.

"I approve entirely of the resolutions and recommendations of the society.

* * * * * * * * *

"Whatever may be the intrinsic value of the remains of former times which are found in the United States, it is necessary that they should at least be correctly described, and that existing gross errors should be corrected; and I repeat my conviction that, though ardent, Messrs. Squier and Davis are animated by that thorough love of truth which renders their researches worthy of entire confidence.

* * * * * * * * *

"I have the honor to be, &c.,

"ALBERT GALLATIN.

"Prof. J. HENRY,
"*Secretary of Smithsonian Institution.*"

At a regular meeting of the American Ethnological Society, held at the house of the Hon. ALBERT GALLATIN, on the evening of the 4th of June, the president laid before the members a communication from Professor J HENRY, Secretary of the Smithsonian Institution, transmitting, for the examination and opinion of the society, a MS. work on the Ancient Aboriginal Monuments of the United States. On motion, the letter and accompanying MS. were referred to a committee consisting of EDWARD ROBINSON, D. D., JOHN R. BARTLETT, Professor W. W. TURNER, SAMUEL G. MORTON, M. D., and Hon. GEORGE P. MARSH, to report upon the same. At a subsequent meeting of the society, this committee submitted the following report and resolutions, which were unanimously accepted and adopted:

REPORT.

The committee of the American Ethnological Society, to which was referred the communication of the Secretary of the Smithsonian Institution, transmitting a manuscript work, entitled "ANCIENT MONUMENTS OF THE MISSISSIPPI VALLEY, *comprising the results of Extensive Original Surveys and Explorations,*" by E. G. SQUIER and E. H. DAVIS, beg leave to report, that

They have examined the work in question, and regard it not only as a new and interesting, but as an eminently valuable addition to our stock of knowledge on a subject little understood, but in which is felt a deep and constantly increasing interest, both in our country and abroad. In their judgment, the work is worthy of the subject, and highly creditable to the authors. Its chief features are, a scientific arrangement, simplicity, and directness of statement, and legitimate deduction from facts, while there is no attempt at mere speculation or theory. If published, it will be an enduring monument to connect the names of the investigators in honorable and lasting remembrance with the great subject of American Archæology.

The existence and progress of these investigations were made known to the society by correspondence early in the year 1846; and in June of that year specimens of the relics recovered, accompanied by numerous maps and plans of ancient earthworks and sectional views of the mounds from which the remains were taken, were laid before the society by Mr. Squier in person. These excited deep interest and surprise in all who saw them; and the society immediately took measures to encourage further investigation, and secure the publication, under its own auspices, of the important results already obtained. A few months later, the chairman of the present committee, being in Ohio, was enabled, through the kindness of Messrs. Squier and Davis, to visit several of the more important monuments in the immediate vicinity of Chillicothe, and, among these, "Mound City," so called, from which very many of the minor relics and specimens were procured. He was struck with the accuracy of the plans and drawings, as well as of the accounts which had been laid before the society, and bears full testimony to the fidelity and integrity with which the process of investigation and delineation has been conducted.

During the last and present season the researches of these gentlemen have been actively prosecuted and widely extended, and the above work, largely illustrated, comprising the results, has been prepared. These results are so numerous and important, and consequently such is the extent and magnitude of the work itself, as to put its publication beyond any means which the society can command. Under these circumstances, your committee learn with pleasure that preliminary arrangements have been made for its publication by the Smithsonian Institution, among its "Contributions to Knowledge." It can only be a matter of sincere gratification to this society to see that which it cannot itself accomplish for the history and antiquities of our country, taken up and carried out under such favorable auspices; and they cannot but rejoice that an opportunity is thus afforded to that noble institution of opening its high career by fostering scientific researches into the interesting problems connected with the Ante-Columbian history and Aboriginal monuments of our own country.

In view of these facts, your committee would recommend the adoption of the following resolutions by the society:

Resolved, That this society regard the researches of Messrs. Squier and Davis as of very great importance in American Archæology, and as casting much light upon our aboriginal antiquities, especially upon the character and habits of the earliest races which had their seat in the Mississippi valley.

Resolved, That we regard the work prepared upon this subject as one of great general interest, and as worthy to be adopted for publication by the Smithsonian Institution, both as resting on original researches, and as affording remarkable illustrations of the history of the American continent.

Your committee would also append to this report the accompanying letters from Samuel G. Morton, M. D., of Philadelphia, and Hon. George P. Marsh, of Vermont, both members of this society, and joint members of this committee.

All of which is respectfully submitted.

EDWARD ROBINSON,
JOHN R. BARTLETT, } *Committee.*
W. W. TURNER,

NEW YORK, *June*, 1847.

NEW YORK, *June* 9, 1847.

I have examined with much interest and attention the manuscripts, drawings, and ancient relics in the possession of Mr. E. G. Squier, and am happy to say that my previous impressions concerning the value of the researches of that gentleman and his associate are fully confirmed. It is fortunate for the cause of American Archæology that the first systematic attempt at its elucidation should have been conceived and executed in so truly philosophical a spirit; and rich as this age already is in antiquarian lore, it has, I think, received few more important contributions than that which the enlightened and generous zeal of these two private gentlemen is about to confer upon it. The Smithsonian collections could not begin with a more appropriate or creditable essay; and I hope that every facility may be afforded to the authors in bringing before the public the results of their honorable labors in as suitable a form and with as little delay as possible.

GEO. P. MARSH.

PHILADELPHIA, *June* 8, 1847.

As a member of the committee of the American Ethnological Society, appointed to report on the memoir on American Archæology, by Messrs. E. G. SQUIER and E. H. DAVIS, I have great pleasure in saying that after a careful and repeated inspection of the materials in the hands of those gentlemen, I am convinced they constitute by far the most important contribution to the Archæology of the United States that has ever been offered to the public. The number and accuracy of their plans, sketches, &c., have both interested and surprised me, and it is gratifying to learn that the preliminary arrangements have been made for their publication under the honorable auspices of the Smithsonian Institution.

SAML. GEORGE MORTON.

The memoirs of Messrs. Squier and Davis will occupy the greater portion, if not the whole, of the first volume of the Contributions. The illustrations will consist of fifty-five quarto plates of the mounds, earthworks, and maps of the adjacent country; also, of about two hundred wood-cuts, principally delineations of the various articles found in the mounds. Those who consider no branch of knowledge of any value but such as relates to the immediate gratification of our physical wants, have objected to the acceptance of this memoir as one of the first publications of the institution; but it must be recollected that the will of Smithson makes no restriction in favor of any particular kind of knowledge, and that each branch is, therefore, entitled to a share of his bequest. The Ethnological memoir of Messrs. Squier and Davis was the first, of the proper character, presented for publication, and hence it was entitled to the first place in the series of Smithsonian Contributions. Besides this, it furnishes an addition to a branch of knowledge which is at this time occupying the attention of a large class of minds, and which cannot fail to be interesting to every intelligent person who would learn something of the changes to which man has been subjected.

One of the volumes of the Contributions will contain a sketch of the life of Smithson, by the Chancellor. The materials for this have been collected from the several volumes of the Transactions of the Royal Society, and the scientific journals of the beginning of the present, and the latter part of the last century. The first volume will be published as soon as the wood-cuts and plates, now in the course of preparation, are finished.

Besides the memoirs before mentioned, a number of others have been presented, some of which, though apparently of interest, and the product of thought and labor, were not of the character required by the resolution of the board, and these have either been returned to the authors, or are in the possession of the Secretary. A number of others have also been provisionally adopted, or are in the course of preparation. Some of these are on the most abstruse parts of physical science, and all will do honor to the intellectual character of our country. Though the number of original memoirs which will be found worthy of a place in the Contributions will probably not be large, yet it will, perhaps, be best to set apart a definite portion of the income of the bequest—as, for example, at present three or four thousand dollars annually—to defray the expense of this part of the plan of increasing knowledge. A considerable portion, however, of the sum thus expended will be returned to the institution in the form of additions to its library. I may also suggest, in this place, the propriety of the adoption, by the board, of a resolution inviting all engaged in original research to send the results of their labors for publication in the Smithsonian Contributions.

The board also directed me to commence the collection of apparatus, and I accordingly sent orders to Europe, to the amount of twelve hundred dollars, for the purchase of such articles as could not be procured in the United States. Most of the instruments have been received, and will be found of importance, not only in the way of original research, but also in illustrating some of the most interesting and recent phenomena of physical science, as well as serving as samples for imitation to the artists of this country. It was thought that these articles would be admitted free of duty, and a petition to this effect was presented to the Secretary of the Treasury; but, though this officer is well known to be much interested in the prosperity of the institution, such is the nature of the law that the duty could not be remitted.

There is an article of apparatus which, within a few years past, has opened almost a new world of research in the phenomena of life and organization, the use of which is now indispensable in advancing our knowledge of physiology and its kindred branches of science. I allude to the achromatic microscope, to increase the power of which, the artists of Germany, France, and England have vied with each other. On account of the small number of persons who are capable of constructing the proper lenses, the best specimens of this instrument are very scarce in this country, and can be procured only at a great expense. Under these circumstances, it was a matter of much interest to learn, from a source which could be relied upon, that an individual in the interior of the State of New York had successfully devoted himself to the study of the microscope, and that he was able to produce instruments of this kind which would compete with the best of those constructed in Europe. In order to do justice to the talents and labors of this person, as well as to furnish the institution with a valuable instrument of research, I requested him to construct a microscope, to be paid for out of the funds for the purchase of apparatus, provided that a commission, appointed by myself, should find it capable of producing certain effects. This proposition was accepted, and the result will probably be given to the board at the next meeting.

Preparations have also been made for instituting various lines of physical research. Among the subjects mentioned in the programme as an example for the application of the funds of the institution, is terrestrial magnetism. I need scarcely say that this is a subject not only of high interest in a theoretical point of view, but also in its direct reference to navigation and the various geodetical operations of civil and military life. A resolution of Congress, authorizing the exploration of the mineral lands adjacent to the great lakes, has given to us the means of advancing this branch of knowledge with but little expenditure of the funds of the institution. The Secretary of the Treasury readily agreed to the proposition that there should be added to the mineralogical and geological surveys of these regions, determinations of the dip, the variation, and the intensity of the magnetic forces, provided that the Smithsonian Institution would furnish one set of the instruments, and take charge of the direction of the observations, and of reducing and publishing them. In the survey of the mineral lands in the vicinity of lake Michigan under Dr. Jackson, Dr. Locke, of Cincinnati, has been employed with his own apparatus; and to supply the necessary instruments for the survey in Wisconsin, preliminary steps have been taken to procure other instruments from London.

Another subject of research mentioned in the programme, and which has been urged upon the immediate attention of the institution, is that of an extensive system of meteorological observations, particularly with reference to the phenomena of American storms. Of late years, in our country, more additions have been made to meteorology than to any other branch of physical science. Several important generalizations have been arrived at, and definite theories proposed, which now enable us to direct our attention, with scientific precision, to such points of observation as cannot fail to reward us with new and interesting results. It is proposed to organize a system of observations which shall extend as far as possible over the North American continent; and in order to this, it will be necessary to engage the co-operation of the British government. I have accordingly addressed a letter on this subject to Lieutenant Colonel Sabine, corresponding secretary of the Royal Society, who assures me that, as soon as the plan is fully matured for this country, there will be no difficulty in establishing a system of corresponding observations in the British provinces. I have also addressed letters to several gentlemen distinguished for their attainments in meteorology, asking for suggestions as to the plan of observation; and I beg leave to refer the board to the accompanying report of Prof. Loomis, of New York University, and also to the communication of Prof. Espy, received in answer. (Appendix Nos. 2 and 3.) The former contains an exposition of the advantages which may be derived from the study of meteorology, and what has been done in this branch of science in this country, and what encouragement there is for the further prosecution of the same subject, together with a general plan of operations. The present time appears to be peculiarly auspicious for commencing an enterprise of the proposed kind. The citizens of the United States are now scattered over every part of the southern and western portion of North America, and the extended lines of telegraph will furnish a ready means of warning the more northern and eastern observers to be on the watch for the first appearance of an advancing storm.

All which is respectfully submitted.

JOSEPH HENRY,
Secretary.

To the Regents *of the Smithsonian Institution.*

APPENDIX No. 1.

Extract from a communication of Professor Jewett, Assistant Secretary of the institution, acting as librarian.

My dear sir: As I do not expect to have the pleasure of seeing you again before the meeting of the Regents, I will, with your indulgence, refer to some of the principal matters which will require attention in commencing the library. They would no doubt all occur to you in their order, but I have thought you might find it convenient to have this part of the business in some degree prepared to your hands. A great deal of preparatory work is to be gone through with, before any books can be placed on the shelves.

1. On the plan proposed for the library, it seems to me that the first thing to be done is to make arrangements for obtaining catalogues, printed or in manuscript, of the principal libraries of the United States; to examine these libraries, as far as can be done personally, in order to know their general character, the statistics of their increase, &c.; and to form such alliances with the librarians as will be indispensable in making the library of the institution, in conformity with the suggestion of Dr. Bache, a supplemental one, and a centre of bibliographical reference. Some libraries possess printed catalogues complete nearly down to the present time; others are several years behindhand. It will be necessary to procure manuscript catalogues in continuation of those which have been printed, and to make arrangements for receiving, from month to month, or from year to year, lists of all future accessions. These supplementary catalogues should all be prepared on a uniform plan. The titles should be written on cards of the same size, so that they may be placed together in one alphabetical arrangement, in order to facilitate research. A mark placed on the back of each card will designate the library from which it came. Now, in every library with which we are in correspondence some one must be employed to do this. It would be merely clerk's labor, where the catalogues are properly kept, and no doubt the librarian or assistant might in every case be induced to undertake it for a small compensation.

2. The next thing to be done will be to make arrangements for procuring the books to which we are entitled by the 10th section of the charter of the institution. Unless something be done, this provision, in course of time, will bring in comparatively few books in a year. I have no doubt that publishers generally would readily send their books, if the subject were properly presented to them, and arrangements made by which they could transmit them to Washington without subjecting the institution or themselves to expenses altogether disproportioned to the value of the books.

It has occurred to me that perhaps the several district clerks might be induced to attend to the business: it is perhaps legally their duty to do so, but I suppose it would be unsafe to rely upon their performing faithfully such an unexpected duty, unless they received for it some additional compensation. Besides this, a circular might be printed and sent to publishers, setting forth the advantages which would result directly to the cause of letters, and indirectly to themselves, from compliance with this requirement. By these means I think we should obtain nearly all the publications of importance issued from the American press.

3. The selection of books for the first purchase must be made. This will, I suppose, comprise three classes of works: 1. Those which may be immediately needed in the scientific department; 2. Bibliographical works and descriptions, histories and catalogues of similar institutions; and, 3. The general collection, consisting of the memoirs, transactions, and journals of the learned societies of Europe and America. These three classes of books will form a library quite unique, and one of great utility. The catalogue, if it be made with fulness and accuracy, will be a valuable publication. I think, further, that a somewhat extended list of books should be made out for future purchases. These lists should be intrusted to honest and faithful men in some of the principal book marts in Europe, with orders to buy the books whenever they can find them—at say one-half *the ordinary prices.* In this way we should obtain at very low prices great numbers of the books which we shall want. Of course, the same list should not be left with different men. The work should be done with care, and by consultation with the best scholars in the country. It will be difficult to find the necessary bibliographical *helps.* The best collection of them in the country is in the library of the Brown University, but this is very imperfect.

4. The first *purchases* are to be made, and the arrangements for future purchases. These, of course, should not be commenced until the lists are as far completed as they can judiciously be in this country.

5. Another subject contemplated in the programme of organization, and which should receive immediate attention, is the procuring of copies of some of the most celebrated *works of art.* It will probably be best to confine the purchases at first principally to plaster casts of some of the finest specimens of ancient and modern statuary. These can be procured very cheap, and convey, of course, a perfect representation of the original. I have no doubt that for a public institution, and one under national auspices, we could, whenever we desire it, obtain permission to take casts directly from the statues.

The expense of doing so would of course be somewhat greater than that of purchasing such copies as might be found in the market, but a small difference in expense is not to be thought of in such a case. It would further be desirable to commence the purchase of the models of antiquities, such as models in cork of some of the houses, temples, theatres, baths, &c., &c., in Pompeii and Herculaneum. These can be procured at comparatively small prices. Models of every interesting part of Pompeii which has been excavated, presenting in miniature a perfect view of nearly the whole on the scale of 1 foot to 150, might be procured for about $2,000. It might also be well to procure a few Etruscan vases; also a few antique coins and medals, sufficient to convey some illustration of numismatics, as a subsidiary branch of history. The Regents should of course decide what proportion of the appropriation for collections should each year be expended for these purposes. I will merely remark that $1,000, or even $500 at the outset, prudently expended, would procure a very interesting collection.

I have thus stated quite in detail the work which must be done before the library can be ready for use, or rather before any part of it can be placed upon the shelves. Before it can be ready for use, much more is to be done in arranging and cataloguing. To lay properly the foundation of a large library is a slow work, and much time must necessarily be consumed in producing but small visible results.

I am, my dear sir, very truly, your friend and servant,

C. C. JEWETT.

PROFESSOR HENRY, LL. D.,
Secretary Smithsonian Institution.

APPENDIX No. 2.

Report on the Meteorology of the United States: By Professor LOOMIS. *Submitted to the Secretary of the Smithsonian Institution.*

MY DEAR SIR: Believing that the science of meteorology has now arrived at that stage of advancement in which a more powerful combination of observers is needed to secure any rapid progress, I fully concur in the importance of establishing an extended system of observations under the direction of the Smithsonian Institution, and propose in this report briefly to inquire,

I. What advantages society may expect to derive from the study of meteorology, particularly that branch of it which relates to the phenomena of storms.

II. What has already been done in this country, 1st, towards making the necessary observations; and, 2d, towards deducing from the observations general laws.

III. What encouragement there is to a further prosecution of the same researches; and,

IV. I shall offer a plan for securing these advantages in their fullest extent.

I. Of what importance to society is the study of meteorology?

Very little argument is needed to prove that our comfort and convenience, and not unfrequently our lives and property, are dependent upon meteorological phenomena. This is proverbially true of the mariner. The moment he embarks upon the treacherous sea, he finds himself at the mercy of the winds. His life often depends upon the fidelity with which he watches every change in the aspect of the sky. In a single hour he may exchange the deceptive calm for the fatal tornado. The number of disasters upon the sea is frightful, and is far greater than is generally known. In the gale of December 15, 1839, 89 vessels were wrecked on the Massachusetts coast; and of these, 61 on a single cape. In the great hurricane of 1780, 13 battle-ships were lost, and 16 more dismasted. England and America alone suffer an annual loss from wrecks of more than 1,000 vessels, and nearly one-half of this is on the American coast.

But how can the study of meteorology benefit the sailor? Will it enable him to calm the tempest—to subdue the raging of the sea? This we do not expect; yet, if he can anticipate the approach of a storm even by a few hours, he may generally place himself beyond the reach of its fury. Is it in the power of science to enable the navigator to anticipate the coming tempest? If so, then it would be difficult to name a subject of more vital importance to our commerce. How far this object has been already attained, and what encouragement there is to expect further discoveries, I shall consider hereafter.

The sailor is not the only person who has an interest in the study of meteorology. Although but a small part of the population of the United States are directly engaged in foreign commerce, yet so important has this department of industry become, and so interwoven with all the business of the country, that there is not a trade or profession which does not feel the shock of any great disaster at sea. Aside from this indirect interest, the farmer is directly dependent upon the weather for the consummation of his plans, almost equally with the sailor. Severe drought or excessive rains, untimely frost or a scorching sun, may blast all the hopes of the husbandman. Here it may be asked, do you expect to produce rain or sunshine at pleasure? Probably not. But if we can anticipate the general character of a season, the farmer may regulate his time of planting or the nature of his crops, so as to be least injuriously affected by unpropitious weather; so that, if we cannot strip the lightning of its power, we may at least direct it harmlessly to the earth.

Again, an extensive series of meteorological observations may prove of immense importance to the scientific physician. It cannot be doubted that the salubrity of a climate is to a great extent dependent upon its meteorology—on its mean temperature, the range of the thermometer, the suddenness of its changes, the moisture of the air, excessive rains or unusual droughts, &c. To trace the connexion between these causes and prevalent diseases, requires an accumulation of precise meteorological observations made in every variety of exposure, and continued for a long period of time. That it is possible to discover such a connexion, if it really exist, cannot admit of a reasonable doubt; nor is it difficult to anticipate the important consequences which must flow from it. To discover the cause of disease is the first step towards a cure; and it is by no means chimerical to suppose that a complete system of meteorological observations throughout the United States might be the means of extending the duration of human life.

It cannot, then, be questioned that meteorology is a subject of the greatest practical importance, *provided* it has any solid foundation for a science. If the laws of storms can be discovered, this knowledge must be of the highest importance to mankind, particularly to those who are employed in navigating the sea. If the prevalent character of a season can be anticipated, it would save the husbandman much bitter disappointment from the failure of his crops. If the influence of climate upon disease could be detected, it might add years to the mean duration of human life. What encouragement there may be to anticipate that these results will ever be attained, I shall consider after inquiring—

II. What has already been done for the promotion of meteorology,

1, In the way of making the necessary observations.

Previous to the year 1819, no combined systematic effort had been made in this country for the promotion of meteorology. Registers had been industriously kept by various private individuals, but they were without any concerted action. In 1819, under the direction of the then Secretary of War, John C. Calhoun, a system of meteorological observations was commenced at the different military posts, which has been continued to the present time. This was a highly important movement, and was prompted by a most liberal spirit. It has furnished us with an approximate knowledge of the mean temperature of a considerable number of stations, many of them remote from the more populous parts of the United States. It should, however, be remembered that the instruments provided never exceeded a thermometer and a rain-gauge; and the observations, therefore, had of necessity a limited range.

In 1825, a similar system of observations was introduced into the State of New York, almost without modification. Each of the academies incorporated by the Board of Regents was furnished with a thermometer and a rain-gauge, and was required to keep a register, after a prescribed form, in order to be entitled to a portion of the public literary fund. This system has now continued for more than twenty years, and the number of academies reporting has increased from ten to forty. The plan was highly creditable to the public spirit and scientific taste of New York. It was a movement in advance of public sentiment in the other States, and the observations were, perhaps, as extensive as it was expedient to undertake at that time. These observations have determined, with considerable accuracy, the mean temperature of the State; and the annual report contains a vast amount of important meteorological statistics.

More recently, Pennsylvania has set an example of the same kind to her sister States. In 1837 the legislature of that State appropriated $4,000 for the advancement of meteorology; and out of this sum, which was placed at the disposal of a joint committee of the American Philosophical Society and Franklin Institute, a barometer, two common thermometers, a self-registering thermometer, and a rain-gauge, were purchased for each county in the State, to be placed in the hands of some skilful observer who should volunteer to keep a journal of the weather, according to a common form prescribed by the committee. The observations were commenced with little delay, and have been regularly continued. Here are made observations of the barometer and thermometer three times a day; of the self-registering thermometer; the winds estimated for sixteen points of the compass; the depth of rain; and, at some stations, observations of the dew-point.

In the year 1843, the system of observations at the military posts was reorganized upon a scale more in accordance with the claims of science. They now comprise observations of the barometer, attached and external thermometer, wet-bulb thermometer; direction and force of the wind; direction, velocity, and amount of clouds; each at four hours of the day, viz: sunrise, 9 a. m., 3 and 9 p. m.; together with the amount of rain, and the times of its beginning and ending.

Thus it appears we have observations from the general government at about sixty posts, stretching along the entire Atlantic coast, the gulf of Mexico, the Indian territory beyond the Mississippi, and the chain of the northern lakes. Next come the observations of two large States, New York and Pennsylvania. And then we have amateur observers, pretty numerous in New England—scattered more sparingly over the south and west.

I now come to the inquiry, what progress has been made,

2, Towards deducing from these observations general laws.

In the list of philosophers who have contributed to create science out of the crude materials furnished by observation, I shall first mention Mr. Redfield. His first paper on the storms of the Atlantic coast appeared in April, 1831, in volume 20 of the American Journal of Science. This paper gives a full account of the hurricane of September, 1821, which was traced from the West India islands northward along the whole line of our coast. It contained also a notice of the storm of August 17, 1830, and two or three other storms of the same year. From a comparison of all the observations, Mr. Redfield derived the conclusion that those storms were great whirlwinds. In 1833 he published the following general propositions, as embodying the results of his investigations:

1. The severe storms of the Atlantic coast often originate in the tropical latitudes, where they are distinguished by the name of *hurricanes.*

2. These storms cover, at the same moment of time, a surface whose diameter varies from one to five hundred miles, and in some cases they have been much more extensive. They act with diminished violence towards the exterior, and with increased energy towards the interior.

3. While south of the parallel of 30° these storms pursue their course towards the west, on a track which inclines gradually to the northward. In the vicinity of latitude 30° their course changes somewhat abruptly to the northward and eastward, and the track continues to incline gradually to the east, towards which point, after leaving the lower latitudes, they advance with an accelerated velocity. The rate of progress may be estimated at from 12 to 30 miles an hour.

4. The duration of the storm at any place within its track depends upon its extent, and the rate of velocity with which it moves.

5. The direction of the wind over the greater portion of the track is not the direction of the progress of the storm.

6. In the lower latitudes, while drifting to the westward, the direction of the wind at the commencement of these storms is from a northern quarter, usually from northeast to northwest, and during the latter part of the gale, it blows from a southern quarter of the horizon.

7. North of the parallel of 30°, and while pursuing their course to the northward and eastward, these storms commence with the wind from an eastern or southern quarter, and terminate with the wind from a western quarter.

8. On the outer portion of the track, they exhibit at their commencement a southerly wind, which, as the storm comes over, veers gradually to the westward, in which quarter it terminates.

9. Along the central portion of the track, the first force of the wind is from the southeast; but after blowing for a certain period, it changes sud-

denly to an opposite point, from which quarter it blows with equal violence, till the storm has passed over: it is under this portion of the storm that we notice the greatest fall of the barometer, and the mercury usually begins to rise a short time previous to the change of wind.

10. On the inner portion of the track the wind commences from a more eastern or northeastern point of the horizon, and afterwards veers by north to a northwest or westerly quarter, where it finally terminates.

11. Hence Mr. Redfield infers that the portion of the atmosphere which composes the body of the storm blows in a horizontal circuit around a vertical axis of rotation, which is carried onward with the storm, and that the direction of the circuit is from right to left.

12. The barometer always sinks while under the first portion of the storm, and rises again under the last portion of the gale.

In 1835 Mr. Redfield published an analysis of several additional storms which visited the American coast, and accompanied his paper with a chart, upon which eleven of these tracks were carefully represented. In subsequent years Mr. Redfield continued his investigations, and in 1846 he published an analysis of three additional hurricanes, making sixteen storms whose tracks are delineated upon his chart of the Atlantic coast. The results of all these investigations served to confirm substantially the conclusions published in 1833.

In the Journal of the Franklin Institute for April, 1836, Mr. Espy commenced the publication of a series of essays, in which he announced a new theory of storms; and he has since continued his researches up to the present time. The following generalizations, given in his own words, are the latest at which he has arrived:

1st. The rain and snow storms, and even the moderate rains and snows, travel from the west towards the east, in the United States, during the months of January, February, and March, which are the only months yet investigated.

2d. There is a depression of the barometer near the central line of the storm.

3d. The central line of minimum pressure is generally of great length from north to south, and moves sideforemost towards the east.

4th. This line is sometimes nearly straight, but generally curved, and most frequently with the convex side towards the east.

5th. The velocity of this line is such, that it travels from the Mississippi to the Connecticut river in about twenty-four hours; and from the Connecticut to St. John, Newfoundland, in nearly the same time, or about thirty-six miles an hour.

6th. When the barometer falls suddenly in the western part of New England, it rises at the same time in the valley of the Mississippi, and also at St. John, Newfoundland.

7th. In great storms, the wind, for several hundred miles on both sides of the line of minimum pressure, blows towards that line directly or obliquely.

8th. The force of the wind is in proportion to the suddenness and amount of the barometric depression.

9th. In all great and sudden depressions of the barometer, there is much rain or snow; and in all sudden great rains or snows, there is a great fluctuation of the barometer.

10th. Many storms are of great and unknown length from north to south, reaching beyond our observers in the gulf of Mexico, on the one hand, and beyond the northern lakes on the other, while their east and west diameter is comparatively small. The storms, therefore, move side-foremost.

11th. Most storms commence in the " far west," beyond the stations of our most western observers; but some commence in the United States.

12th. When a storm commences in the United States, the line of minimum pressure does not come from the " far west," but commences with the storm, and travels with it towards the east.

13th. There is generally a lull of wind at the line of minimum pressure, and sometimes a calm.

14th. When the wind changes to the west, the barometer begins to rise.

15th. There is generally but little wind near the line of maximum pressure, and on each side of that line the winds are irregular, but tend outwards from that line.

16th. The fluctuations of the barometer are generally greater in the northern than in the southern parts of the United States.

17th. The fluctuations of the barometer are generally greater in the eastern than in the western parts of the United States.

18th. In the northern parts of the United States, the wind, in great storms, generally sets in from the north of east, and terminates from the north of west.

19th. In the southern parts of the United States the wind generally sets in from the south of east, and terminates from the south of west.

20th. During the passage of storms the wind generally changes from the eastward to the westward by the south, especially in the southern parts of the United States.

The importance of verifying, modifying, or refuting these generalizations, will appear more fully by a consideration of the following theory, which first led to the adoption of the plan of laying down the phenomena of storms on maps, as here recommended to you:

1st. When the air near the surface of the earth in a particular locality acquires a higher temperature or a higher dew-point than that of surrounding regions, it will ascend, on account of a less specific gravity—perpendicularly if there is a calm.

2d. As it ascends it comes under less pressure and expands, and becomes colder by expansion, about one degree and a quarter for each hundred yards.

3d. The dew-point falls about one-quarter of a degree, by the expansion of the vapor, for each hundred yards; and, therefore, when the ascending air rises as many hundred yards as the dew-point is below the temperature of the air at the surface of the earth in degrees of Fahrenheit, the cold of expansion of the air will begin to condense the vapor contained in it, and thus form cloud.

4th. As soon as the vapor begins to condense into cloud, the latent caloric will begin to be evolved, which will diminish the cooling effect of its expansion in its further ascent, sometimes a little more and sometimes a little less than one-half, according as the dew-point is above or below 70° of Fahrenheit.

5th. When the air has ascended high enough to have condensed by the cold of expansion, from diminished pressure, one-hundredth of its weight of vapor, its temperature will be about 48° warmer from the evolution of the latent caloric than it would be by going up to the same height without vapor in it, and will then be about 48° warmer than the air around the cloud at the same elevation, and of course about one-tenth lighter.

6th. The air in the cloud being thus specifically much lighter than the surrounding air, will ascend, and, in ascending, spread out in all directions above, overlapping the air of surrounding regions, and thus causing the barometer to rise all round the cloud to a distance proportional to the magnitude of the cloud.

7th. Whilst the barometer is rising all round the cloud from the increasing weight of the air, it will fall under the central regions of the cloud in proportion to the quantity of air spreading out above.

8th. The air near the surface of the earth will now rush in on all sides from the regions around the cloud, where the barometer stands high, towards the central regions, where the barometer stands low, with a volocity proportional to the square root of the difference of pressure.

9th. The air thus rushing in under the cloud on all sides will ascend, and carry up its vapor with it, and will condense it into cloud by the cold of expansion from diminished pressure, as before, and thus the process of cloud-forming will be continued.

10th. As the principal part of this upmoving current of air is in the upper regions of the atmosphere, which move all the year, over the United States, from west to east, the cloud, with its whole column of light air, must also move in the same direction.

"Dr. Hare has turned his attention to the electrical phenomena which accompanies the more violent exhibitions of the storm when it assumes the form of a tornado. He agrees with Mr. Espy in opinion as to inward and upward direction of the wind towards the middle of the storm, but differs from him with respect to the cause of the current. He proposes a definite theory of the phenomena of the tornado, founded on well-known laws of electrical action, combined with facts of observation. It has been fully established by experiment in different parts of the earth that there is an accumulation of positive electricity in the upper regions of the atmosphere, that the surface of the earth relative to the lower stratum of air is slightly negative, and that space void of air may be considered an electrical conductor. From these facts Dr. Hare infers that the surface of the earth, the surrounding atmosphere, and the space immediately around and exterior to the atmosphere, form three concentric spheres, of which the outer and inner are constantly charged with opposite electricity. The arrangement is, therefore, precisely that of a charged leyden jar, of which the exterior sphere is analogous to the outer coating, the surface of the earth to the inner, and the intervening atmosphere to the non-conducting glass. The clouds are insulated conductors floating between the two coatings, and therefore liable to be variously charged by induction as their position relative to each other and the two coatings is varied. In some cases the arrangement may be such as to form a series of steps of intermediate conductors, each electrified by induction, so as to produce a violent ascending current or *convective* discharge from the surface of the earth upwards.

"The theories of Redfield, Espy, and Hare may not be found incompatible in all points; and whatever may be the future state of our knowledge relative to them, they point to definite objects of inquiry, which cannot fail to reward proper observation with a rich harvest of important results."

The idea occurred to me that more might be learned from a complete analysis of a single storm, than from a partial analysis of several storms; and that any storm of strongly marked characteristics, if fully investigated, must prove a complete *experimentum crucis*, at least between the theories of Messrs. Redfield and Espy. I accordingly selected the storm of December 20, 1836, for a thorough examination. I obtained barometric observations from 27 different stations within the United States and the neighboring British possessions. I also obtained meteorological journals, not containing barometric observations, from 28 military posts, from 42 academies in the State of New York, and from five other stations; making 102 in all, besides several stations beyond the probable limits of the storm.

In analyzing these materials, the barometric observations were all graphically represented by curves, showing the fall and rise of the barometer, with the time of its minimum height. Then joining by a line all those places where the minimum of the barometer occurred at the same instant, we are furnished with the means of measuring the rate of progress of the great atmospheric wave. On the southern border of the United States, this velocity varied from 17 to 29 statute miles per hour; and on the northern border from 17 to 37 miles. The leading characteristics of this storm were as follows: After a clear and cold interval, with barometer high, the wind commenced blowing from the south. The barometer fell rapidly; the thermometer rose; rain descended in abundance. The wind veered suddenly to northwest, and blew with great violence. The rain was succeeded by hail or snow, which continues but a short time. The barometer rises rapidly; the thermometer sinks as rapidly. These changes are experienced progressively from west to east.

This storm was not circular. The area of rain and snow was about 500 miles broad from east to west. Its length from north to south was known to be 800 miles, and probably was not less than 1,500. For nearly a day before the crisis, the wind blew from the southern quarter, and generally for several hours from the southeast. After the minimum of the barometer, the wind blew with great violence from nearly the opposite point; commonly the northwest. Here was clearly indicated a prevalent tendency of the wind towards a central line; but, unfortunately, the observations embraced only one-half the area of the storm. The oscillation of the barometer showed a steady increase from latitude 25° to Quebec. The centre of the storm, therefore, could not have been south of Quebec, and north of this place we could obtain no observations.

I was now desirous of investigating a storm of marked characteristics which could be *entirely surrounded*, so that more of its features would need to be supplied by conjecture. Two storms which occurred in February, 1842, appeared tolerably well suited to my purpose, and were selected for a new investigation. Great pains were taken to collect materials from every part of the United States. I succeeded in obtaining barometric observations from 64 different stations. I also procured registers, without barometric observations, from 41 military posts, and 22 other stations, making 127 in all, not including registers from several stations too remote to be of any service in the proposed investigation.

I commenced the analysis of the storm of February 1–5, by following the same course I had pursued with the storm of 1836, viz: representing the barometric observations by curves which should exhibit the fall and rise of the mercury, with the time of minimum height; and from the time of minima I proposed to deduce the progress of the storm. But I was disappointed in my expectations. I did not obtain such a uniform rate of Progress as I had anticipated. After some time I perceived that my observations embraced two centres of disturbance; that I had got at least two storms in close juxtaposition, and interfering with each other. I then discovered that my lines of barometric minimum represented relations which were *extremely complex*, and were not well adapted to my purpose, which was the development of physical causes. I therefore sought for some mode of graphically representing the observations which should be founded upon *simple relations*, and be better adapted to suggest the causes of the phenomena. I at last settled upon a method which appears to me well suited to this purpose, and substituted for lines of *minimum pressure*, lines of *equal pressure*. Having determined, as well as I was able, the mean height of the barometer at each station, I compared each observation with the mean. I then drew a line upon a map of the United States, passing through all those places where the barometer stood at its mean height. This line may be called the line of mean pressure. I then drew a line through all the places where the barometer stood 2 inches above the mean, and another for 4 inches above the mean. So, also, I drew a line through all the places where the barometer stood 2 inches below the mean; another for 4 inches below; and others for 6 inches, 8 inches, and 100 inches below the mean height. These lines must, from the nature of the case, be continuous curves; and the centre of these curves must be a point of maximum or minimum pressure. Near the middle of a great storm we find a point of minimum pressure—that is, *the centre of a vortex;* and the lines of equal pressure will indicate at a glance whatever connexion there may be between the weight of the air and the direction of the wind.

Upon a similar principle, all the observations of the thermometer were graphically represented upon the same chart. A line joining all those places where the thermometer stands at its mean height for the given hour and month is marked zero, and may be called the line of mean temperature. Another line joins all those places where the thermometer is 10° above the mean, and others for 20° and 30° above the mean. So, also, lines are drawn for 10° and 20° below the mean temperature. There are also continuous lines surrounding a point of maximum or minimum thermometric disturbance; not points of maximum or minimum temperature absolutely, for we only regard the deviation from the mean temperature of the place for the given hour and month. These barometric and thermometric curves exhibit some conformity to each other, but are far from being identical. The direction of the wind is represented by arrows, and its force is indicated, so far as convenient, by their length.*

Other phenomena are now indicated by *colors*. Those regions where the sky was unclouded, or where the cloudiness was less than one-half, are colored blue; those where the sky was entirely overcast, or the cloudiness exceeded one-half, but without rain or snow, are colored brown. Those regions upon which snow is falling, are colored green; and those where rain is falling, are colored yellow. Thus, nearly every important circumstance of a storm is presented to the eye at a single glance. All these particulars will be understood from the two accompanying charts, illustrating the progress of the storm of February 16, 1842.

In both the storms of February, 1842, after they had acquired considerable violence, there was a prevalent motion of the winds inward, with a tendency to circulate around the centre, in a direction contrary to the sun's motion. The motion of the wind, therefore, was neither wholly centripetal nor wholly rotary, but a combination of the two. As long as the wind was moderate, neither of these tendencies was clearly marked, and there were numerous perplexing anomalies, probably occasioned in many instances by the inequalities of the earth's surface. The storm of February 16 travelled in one day 560 miles in a direction N. 53° E., making its velocity 23 miles per hour. The storm of February 1–5 remained for two days nearly stationary, and then travelled N. 62° E. at the rate of 36 miles per hour. On the whole, then, we may conclude that when storms are violent, and there is a great depression of the barometer, the direction of the wind presents considerable regularity, being spirally inward towards the centre of the storm; but when the winds are moderate, which is the case of most frequent occurrence, this tendency is very fully developed, and the subject demands more particular investigation.

III. I now proceed to inquire what encouragement there is to a further prosecution of meteorological researches.

In all our investigations respecting natural phenomena we assume that the operations of nature are subject to laws, and that these laws are uniform in their operation. A law of nature knows *no exceptions*. There is no place for science except upon this basis. Are storms subject to laws, and are these laws invariable? Such a question may appear almost like trifling, and yet many argue as if they had but feeble faith in these principles. It is presumed that no philosopher will seriously question them; but it may be said that these laws are so complex that they can never be discovered. What right have we to make such an assumption? Have not the laws of nature been actually discovered in many cases in which they appear equally complex? How long is it since comets were believed to rush through the planetary system in defiance of all law; or if subject to law, then a law of such complexity that all attempt to discover it seemed hopeless? Now, these laws appear so simple that we wonder they were not sooner discovered. All the laws of nature appear complex while they remain unknown; but when once discovered, we are surprised at their simplicity. Why should storms form an exception to this rule? Does the past history of meteorological investigations justify such a conclusion? Have our researches been rewarded with no success? Far otherwise. During the brief period that meteorology has been cultivated we have arrived at many important generalizations, which, if not entitled to the name of laws of nature, afford the strongest assurance that such laws exist, and that we are on the eve of their discovery. We have discovered that the great storms of the United States travel nearly from west to east. No instance has yet been found in which a violent storm in these latitudes has travelled from east to west, although some great rain storms have remained nearly stationary for a day or two. Violent storms usually travel at the rate of about 25 miles per hour, although this velocity has been observed to rise as high as 40 miles. These storms are of various dimensions. While summer showers may cover an area of but a few miles, winter storms sometimes have a diameter of 1,000 miles and upwards. The duration of a storm at any place depends upon its extent, and upon the velocity of its progress. If the diameter of a storm is 500 miles, and its progress 25 miles per hour, its duration at a place situated in the centre of the track will be 20 hours, and less for places out of the centre. Hence we may form some estimate of the superficial extent of a storm from its duration at any place. The direction of the wind is generally inward towards the area of rain, and in violent storms there is a tendency to rotation about a vertical axis. Over a rugged country there are so many obstacles to the wind's progress, that observations at the surface of the earth present a great many anomalies; but at sea there are no such obstacles, and the observations of the wind exhibit a greater uniformity and simplicity. The barometer falls under the first half of the storm, and rises as the storm recedes; the centre of the storm coinciding nearly with the greatest depression of the barometer. The passage of this centre is marked by a sudden change of wind to a point of the compass nearly opposite to that from which it had previously been blowing.

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*For an account of the method employed by Mr. Espy in representing the phases of storms, see his communication, appendix No. 3.

The preceding propositions are deductions from a large number of particular cases which have been investigated. If any one of these propositions requires some modification, the fact will be disclosed by a continuance of the same system of observations. This is a legitimate subject of investigation. Further observations will either prove or disprove these propositions. Some of them may require a little modification, although it is believed they are all substantially true.

We are justified, then, in inferring that storms are subject to laws; that these laws are uniform in their operation, and that they may be discovered. We have already made important progress in this discovery, and we are persuaded that we have only to follow up the same methods of investigation, and our labor will be rewarded with more brilliant discoveries. The results of such knowledge are too important to be overlooked. When we have fully learned the laws of storms, we shall be able to *predict* them. This attainment is of the highest practical importance. If the navigator can anticipate the approach of a storm by 24 hours, this interval will be quite sufficient to place him beyond the reach of its fury; and although the landsman could not remove his habitation from the approaching tornado, he might withdraw his family and the most valuable of his effects to a place of security.

When the magnetic telegraph is extended from New York to New Orleans and St. Louis, it may be made subservient to the protection of our commerce, even in the present imperfect state of our knowledge of storms. The severe winter storms which desolate the Atlantic coast come from the valley of the Mississippi, and require about 24 hours to travel from St. Louis to New York. The approach of a dangerous storm might therefore be telegraphed at New York hours before its arrival, while the sky was yet unclouded and the wind propitious, in season to save a fleet of ships from putting to sea, to be engulphed in the bottomless deep. The science of meteorology is already sufficiently advanced to render important service to commerce, if practical navigators would but heed the indications of the barometer, and make themselves familiar with the principles which observation has established.

It is, then, not without reason that we expect to be able to predict an approaching storm, long enough in advance to render such knowledge of the highest importance; but it may admit of more serious question, whether we shall ever be able to predict the general character of a season with sufficient precision to be of any value to the farmer. But why should we despair of ultimately attaining even this result? If one season is remarkable for its cold, and another for its heat, is there no reason for it? Is there not some cause acting upon a grand scale to bring about this result? Is there no cause which brings an excess of winds from the north, or an excess from the south—which brings an unusual amount of precipitation, or an extraordinary degree of cloudiness? And cannot this cause be discovered? This discovery may require the exercise of patience—it may require a long continued series of observations; but to assume that a principle cannot be discovered, is unphilosophical. This is a legitimate subject of investigation, and it is a field in which the laborer cannot fail of reaping his reward. We only need adequate observations—observations sufficiently precise, and upon a scale of proper extent. We conclude, then, that there is the highest encouragement to the prosecution of meteorological inquiries—that by continuing our researches we may hope to arrive at general laws, and that a knowledge of these laws cannot fail to contribute to the wealth and happiness of mankind.

I proceed, therefore, to inquire—

IV. Upon what plan the observations should be conducted to secure the object proposed.

Violent winter storms appear most suitable for investigation, because they are of longer duration, and their features are more strongly marked. The oscillation of the barometer affords the surest criterion for identifying a storm in its progress from day to day; and these oscillations are greatest in winter.

1. How large an area should be covered by our observations, to enable us to investigate advantageously the phenomena of our winter storms?

Our observations ought plainly to embrace the entire region of the storm, and even extend somewhat beyond its margin, for in no other way could we be sure that we had found its limits. Now, the great storms which are experienced between the parallels of 40 and 45 degrees are frequently felt as far south as latitude 30°, and sometimes to 25°. South of this line, the oscillations of the barometer, except in a few rare instances, are quite small; and it is probable that the limiting parallel of the trade winds forms a dividing line between the ordinary storms of the torrid and temperate zones. We should therefore extend our system of observations to the southern margin of the United States. The northern limit of our ordinary winter storms remains unknown. In the storm of December 21, 1836, the oscillation of the barometer increased uninterruptedly with the latitude as far as the most northerly station, Quebec. Only the southern half of the storm was included within the United States. This storm was probably experienced as far northward as to the northern shore of Hudson's bay. We should therefore extend our system of observations to the northern margin of the United States; and to render our system complete, requires the co-operation of the British government to extend the observations to the entire region of Hudson's bay.

If we merely wished to embrace in our observations the area of a storm for a single hour, then the interval between the Mississippi and the Atlantic would ordinarily be sufficient. But we could not thus expect to discover the origin of a storm. We must trace it in its progress from its commencement to its greatest violence, and thence to its decline. By observing *under what circumstances* it takes its rise, we may hope to be able to discover the *cause* of its activity. We should therefore aim to trace every storm from its origin to its close. At the ordinary rate of progress a great storm would travel from the Rocky mountains to the Atlantic in two days. What influence this range of mountains may have upon our storms is unknown, except from conjecture. We cannot suppose that a storm could travel from the Pacific to the Atlantic without experiencing some modification in passing over a range of mountains rising into the region of perpetual snow. What this modification is, can be determined by corresponding observations on both sides of the mountain. I therefore conclude that it is important to embrace in our system of observations the entire continent from the Pacific to the Atlantic, and from the gulf of Mexico to the northern shore of Hudson's bay.

2. At what distance from each other should stations of observation be selected?

If we were investigating the phenomena of a summer shower, it would be indispensable to have stations at very short distances from each other; but in winter storms this is less important. I consider it, however, desirable to have stations at intervals of fifty miles from each other, and such might probably be obtained in the more thickly settled parts of the United States. In other parts of the country this would be impracticable; but I would strive to obtain at least one station for every hundred miles square. At this rate we should need about three hundred observers for the United States. It is not doubted that this number might be obtained; indeed, we have well nigh this number already, but, unfortunately, they are very unequally scattered over the country.

3. What materials have we to depend upon, and what is wanting to complete the plan of one observer to every hundred miles square?

We have the government observations at the military posts, now 57 in number. We have observations from 41 academies in the State of New York, and 25 stations in Pennsylvania. Then we have borometric observations from about 40 other individuals scattered promiscuously over the country; and thermometric observations from about 20 others. There is, besides, a large number of those who have meteorological instruments, which they occasionally consult, but do not feel sufficient interest in the subject to keep a systematic journal. If a grand meteorological effort were made, with a prospect of yielding important results, probably most of those persons might be pressed temporarily into the service. New England is pretty well manned with observers, except in the northern part, where three or four more are greatly needed. Probably, if instruments could be furnished without expense, volunteers might be found to make the observations. New York and Pennsylvania are fully organized; but throughout the remainder of the United States the stations are few and scattered. Excluding Oregon and the Indian territory, the remaining States embrace about a million and a half square miles, and at our lowest estimate would require about 150 observers. We have 50 observers already in the field, leaving 100 to be provided for. How is this deficiency to be supplied? If our government would direct meteorological observations to be made at the principal light-houses along our coast and the chain of the great lakes, it would leave only the interior of the country to be provided for; and if instruments could be furnished without expense, volunteers might probably be found to take the observations at most of the remaining stations.

To extend this system of observations further westward must be attended with serious difficulties. We already have registers kept at most of the military posts in the Indian country; and as new posts are established, it is presumed that the government will direct them to be improved for observations. We may thus hope ere long to obtain a line of stations reaching to the mouth of the Columbia river; and as settlements extend, observations will multiply on the other side of the Rocky mountains. On the whole, then, it is believed we might occupy the whole United States from its northern to its southern border, and from the Atlantic to the Indian territory, beyond the Mississippi, with an army of meteorologists sufficiently numerous to enable us to investigate advantageously the phenomena of our great storms, provided instruments could be furnished gratuitously for about 100 stations; and, moreover, we might probably have a line of observers at unequal intervals, reaching even to the Pacific ocean. The expense of 100 sets of meteorological instruments may be estimated at $3,000.

It is believed that the Smithsonian Institution might undertake to furnish these instruments and organize a grand system of meteorological observations upon this continent, in perfect harmony with the views of James Smithson. Mr. Smithson bequeathed his property, in trust, to this country, *for the increase and diffusion of knowledge among men*. It is believed that by carrying out the plan now suggested, knowledge would be increased and diffused, and it would be that kind of knowledge which would contribute to the comfort and happiness of society, as much as perhaps any other which can be named.

4. Specific plan of operations proposed.

The following is proposed for the consideration of the Regents of the Smithsonian Institution, as the outline of a grand meteorological campaign.

Let a meteorological department of the institution be organized, under the direction of the Secretary, with a suitable assistant. Let a united effort be made to secure for a limited period, and to the greatest possible extent, the co-operation of the general government, the several State governments, scientific societies, and the friends of science throughout the country. Let the general government be requested to give the greatest possible extension to their system of observations at the military posts, and to authorize similar observations to be made at certain light-houses, so far as may be necessary to complete a line of stations at intervals of 100 miles along the whole extent of our coast, and the chain of the northern lakes. Let the regents of the University of the State of New York be requested to reorganize the system of observations in that State, by furnishing barometers to about 20 of their academies, and directing the observations to be reported regularly to Washington. Let the committee having charge of the observations in Pennsylvania be requested to adopt the same plan of observations which shall be agreed upon for the other States, and report regularly to Washington. Let application be made to the legislatures of each of the other States, inviting them to co-operate in this noble scheme, by emulating the examples of New York and Pennsylvania. Let the scientific societies throughout the United States be appealed to, to assist in organizing an efficient corps of observers, each in its appropriate sphere; and let individual observers throughout the country be requested to unite their efforts in one uniform and systematic plan of operations. Let them be requested to report their equipment of instruments, and state whether they will undertake to provide whatever may be wanting, at their own expense. Let then the entire country be divided into sections not exceeding 100 miles square; and in each section not already provided for, let an observer be sought out, who shall volunteer to make the observations if instruments are furnished him. Let then the Smithsonian Institution assume the burden of furnishing the necessary instruments to those who are unable to do it themselves. It is estimated that the sum required for this purpose would not exceed three thousand dollars. Let a form of observations be provided, and instructions to all the observers, who shall report at least quarterly to the Secretary at Washington. Let it be the duty of the meteorologist to take charge of the observations, to discuss and analyze them, and endeavor to deduce from them the laws of storms. Let these investigations be published, in as much detail as may be thought demanded by the claims of science, and let a copy of whatever may be published be forwarded to each observer, in order that he may be stimulated in his work by finding that his labor is not wholly in vain.

Finally, to give to this system its greatest efficiency, the co operation of the British government and of the Hudson's Bay Company is absolutely indispensable. The greater part of our severe storms extend far beyond the limits of the United States on the north. Observations confined to the United States will therefore seldom give us the entire area of a storm, and frequently only half of it. The remaining half must then be supplied by conjecture. This would leave all our investigations in an unfinished and unsatisfactory state. We want a line of stations through Canada, along the shores of Hudson's bay, to the farthest outpost of civilization. At every government station a meteorological journal might doubtless be kept; and it is confidently believed that if the Smithsonian Institution would embark in earnest in a grand meteorological crusade, the British government would cheerfully contribute its efficient co-operation.

A system of observations like that here contemplated, if faithfully prosecuted for one year, would well nigh exhaust the subject. The storms of each year are probably but a repetition of those of the preceding. Nevertheless, it would be unsafe to calculate upon concluding the war after a single year's campaign. Experience in similar cases has shown that it requires considerable time to organize so large a plan of operations, and the system would not, probably, attain its greatest efficiency the first year. It would be unwise, therefore, to calculate upon a less period of operations than three years. But it is believed that in this period, results would be developed which would more than repay all the expense of time and money incurred; while, upon the existing scale of operations, the progress of discovery must be slow and uncertain. In order to enable us to investigate advantageously the phenomena of a single storm, we must have simultaneous observations from a vast number of stations. Observations from a few stations, though continued to the end of time, will not accomplish the same object. How, then, can the Regents of the Smithsonian Institution more faithfully carry out the views of its benevolent founder, than by vigorously prosecuting these researches to their completion? How can they contribute more directly and powerfully to the prosperity of our commerce; and, through commerce, add to the wealth and happiness of the whole country?

I remain, very respectfully, your obedient servant,

ELIAS LOOMIS.

Joseph Henry, LL. D.,
Secretary Smithsonian Institution.

APPENDIX No. 3.

Extract from a communication from Professor Espy on the subject of Meteorology.

My dear sir: I am much pleased to learn from your letter that the Regents of the Smithsonian Institution would probably make an appropriation for the purpose of establishing a series of observations "to solve, if possible, the problem of American storms." I am of opinion that no subject of science is more worthy of the attention of the institution; and in answer to your request that I should furnish you with suggestions on the subject, I refer you, in the first place, to my work entitled "Philosophy of Storms," from page 77 to page 172, for a full development of the plan adopted twelve years ago of investigating the phases of storms, by the joint committee of the American Philosophical Society and the Franklin Institute, of the State of Pennsylvania.

The plan then suggested, and in part carried out, was adopted in the investigation of the phases of storms during the five years in which I was in the service of the government. In my "circular to the friends of science," in which I invited all persons in the United States keeping journals of the weather to send them to the office of the Surgeon General, Washington, I announced my intention to lay down on skeleton maps of the United States, by appropriate symbols, all the most important phases of great storms which might come within the range of our simultaneous observations ; and thus it was hoped we should be able to determine the *shape* and *size* of all storms; whether they are *round* or *oblong;* and if oblong, whether they move *sideforemost* or *endforemost*, or *obliquely;* and to ascertain their *velocity* and *direction* in all the different seasons of the year; the *course* of the wind in and beyond the borders of the storm; the *fluctuation* of the barometer and *change* of temperature which generally accompany storms, and the *extent* to which their influence is felt beyond their borders.

Having obtained observations from a wide extended correspondence, I laid down the phases of the storms on maps, as presented in my first report, and I have continued the same plan in my second report, now ready to be printed. In the investigation of the materials of the second report, comprising the observations of three years and three-quarters, I have discovered no facts contradictory to the generalizations deduced from the winter storms of three months embraced in the second report. I consider it of the highest interest, by an extended series of observations, which I hope the Smithsonian Institution will cause to be made over a much wider territory than my observation embraced, to verify, or, if necessary, modify these generalizations, and also to investigate the laws of summer storms, which I fear cannot be done without much more numerous observers than I was able to procure.*

* * * * * * * * *

The elements of the theory I have given you are the same as those presented in my work on storms; and though I have demonstrated them approximately, and have no doubt of their general accuracy, yet I am convinced that nothing will establish the truth on this subject in such a manner as to carry conviction to every mind but a series of wide extended simultaneous observations, continued for a long time, by numerous observers. Such a series I hope is now about to be made.

It would be inappropriate to extend this communication to a greater length; but I will explain to you at another time some experiments connected with meteorology, which I wish to see performed, on the electricity of steam, and on the specific caloric of atmospheric air and other gases, with the aid of my nephelescope, and on the law of cooling of air in great expansions of air by diminished pressure.

I remain, very respectfully, yours, &c.,

JAMES P. ESPY.

Prof. J. Henry,
Secretary Smithsonian Institution.

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* The generalizations and theory of Mr. Espy are given in the preceding report of Professor Loomis, page 33.

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